ORIGINAL ARTICLE

WATER REGIME OF SOME FIELD CROPS IN TRANSYLVANIA (1964-2002)
REGIMUL DE APĂ AL UNOR CULTURI DE CÂMP ÎN TRANSILVANIA

Z.NAGY, LUCA, E, BERCHEZ, M.

ABSTRACT

This study represents a synthesis of the results of 39 years of researches (1964-2002) regarding the irrigation depth of the principal field crops (wheat, maize, soybean, potato, sugar beet).

Key words: **irrigation, wheat, maize, potato, soybean, sugar beet**

REZUMAT

Acest studiu reprezintă o sinteză a rezultatelor din 39-de ani de cercetări (1964-2002) referitoare la regimul de irigare al principalelor culturi de câmp (grâu, porumb, soia, cartofi, sfeclă de zahăr).

Cuvinte cheie: irigatii, grau, porumb, cartof, soia, sfecla de zahar

Manuscript received 17 February 2003 Accepted for publication: 22 May 2003	JOURNAL Central European Agriculture ISSN 1332-9049

DETAILED ABSTRACT

This study represents a synthesis of the results of 39 years of researches (1964-2002) regarding the irrigation regime of the principal field crops (wheat, maize, soybean, potato, sugar beet). From the analysis of the results of the experiments in Cluj-Napoca it can be ascertained that in the subhumid area of Transylvania, the irrigation of cultures constitutes a resolute method in the achievement of constantly high productions per ha.
The growth of the water rate in this area is of 400-600 m³ water/ha and the irrigation requirements is of 1000-1200 m³ water/ha, carried out in 2-3 watering, especially in the months of July and August, when the plants have a high water consumption.

INTRODUCTION

The conditions in which the research has been accomplished were those of the underwet hillock area of Transylvania.
The partial results of the research were published during many years in numerous scientific papers (1,2,3,4,5), by the staff of the Crop Irrigation Discipline from the University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca.
The results were organized in the experimental field of the Experimental Didactic Station Cluj-Napoca, on an alluvial-colluvial carbonated soil, having a moderate alkaline pH.

MATERIAL AND METHODS

The biological material used in the research was represented by the varieties and hybrids, which have a good adaptability to the specific conditions of Transylvania area.
The irrigation was made, in most cases through aspersion, but it was also carried out the irrigation through drainage at the surface in the case of cultivator plants.
The culture was included in a four years rotation of crops, following the pattern: vegetables, wheat, sugar beet and potato/maize. In order to establish the right time of the watering there were accomplished bimonthly gathers of to collect samples of soil up to the dept of 1,5 m, the humidity being determined with the gravimetrical method.
The technology applied to the crop was the ordinary one, recommended by the same area institutions.

RESULTS AND DISCUSSIONS

The irrigation regime applied each year according to the level of precipitation and to the supply of the soil with water required the application in most of the cases of 2-3 watering, having a rate of 400-600 m³ water/ha.
From among the 39 years of research, only four years did not necessitate the irrigation in order to maintain the humidity level at 50 % of the interval of active humidity.
The results of the watering gave its concrete expression, on an average in the 39 years, through an increase of production as it follows: 1,7 t/ha (32,8 %) wheat, 2 t/ha (30,7 %) corn, 0,77 t/ha (28,5 %) soybean, 8,20 t/ha (28,5 %) potato and 12 t/ha (34,6 %) sugar beet.
The experiments in which had in view the importance of the humidity depth of the soil on the production have proved that the best results were obtained when the moisture of the soil was affected for all cultures, until the depth of 50-75 cm, using rates of watering of 400-600 m³ water/ha. The moisture of the soil beyond this depth has proved to be uneconomical at every culture we studied (table 1. – 8)

Table 1 Precipitation and temperatures, Cluj-Napoca, 1865-2002

Period	Precipitation		Temperatures	
	mm	%	° C	%
1865-1900	610	100,0	7,8	100,0
1901-1950	599	98,1	8,4	107,7
1951-2002	561	92,0	9,1	116,7

Table 2 Classification of years depending on precipitation, 1964-2002, Cluj-Napoca

Specifi-cation	Description of years							
	Excessive droughty	Very droughty	Droughty	Mean	Rainy	Very rainy	Excessive rainy	Total
Numeric	7	5	5	5	7	5	5	39
Percentage	18,0	12,8	12,8	12,8	18,0	12,8	12,8	100
Total	43,6			12,8	43,6			100

Table 3. Irrigation regime at field crops, 1964-2002, Cluj-Napoca

Years	Precipitation (mm)		Character of vegetative period	Water rate per months (m³/ha)						Total Irrigations	Irrigation rate (m³/ha)
	Annual	Vegetative period of year		IV	V	VI	VII	VIII	IX		
1964	527,4	611,6	V.D.	-	-	500	500	-	-	2	1000
1965	455,6	325,8	V.D.	-	-	-	500	900	-	3	1400
1966	594,4	423,8	M.	-	-	-	600	-	-	1	600
1967	431,2	262,0	Ex.D.	-	-	500	600	500	-	3	1600
1968	649,1	485,1	R.	500	-	-	500	450	-	3	1450
1969	578,1	431,4	R.	-	-	-	-	400	-	1	400
1970	882,6	680,0	Ex.R.	-	-	-	-	700	-	1	700
1971	626,3	395,9	M.	-	-	-	-	500	-	1	500
1972	634,3	458,6	V.R.	400	-	-	500	500	-	3	1400
1973	450,6	372,0	M.	-	-	-	-	600	500	3	1100
1974	637,4	501,2	V.R.	500	-	-	400	400	-	3	1300
1975	529,4	470,3	V.R.	-	-	-	-	-	-	0	0
1976	441,8	282,2	Ex.D.	-	-	500	500	500	-	3	1500
1977	414,1	300,8	V.D.	-	-	500	500	500	-	3	1500
1978	702,3	543,1	Ex.R.	-	-	450	450	-	-	2	900
1979	496,3	395,7	M.	-	-	400	400	-	-	2	800
1980	782,8	510,9	R.	-	-	-	-	-	-	0	0
1981	559,0	319,9	Ex.D.	-	-	600	450	450	-	3	1500
1982	449,9	335,5	Ex.D.	-	550	-	500	500	-	3	1550
1983	366,9	296,8	Ex.D.	-	-	800	500	500	-	3	1800
1984	686,1	440,3	Ex.R.	-	-	-	500	500	-	2	1000
1985	592,0	412,7	R.	-	-	-	600	600	-	2	1200
1986	463,0	321,6	M.	-	-	600	600	600	-	3	1800
1987	562,3	339,0	D.	-	-	-	600	600	-	2	1200
1988	498,2	309,1	V.D.	-	-	-	600	600	600	3	1800
1989	699,6	625,5	Ex.R.	-	-	-	-	600	-	1	600
1990	421,5	281,1	Ex.R.	-	-	-	400	400	400	3	1200
1991	682,2	511,8	R.	-	-	-	-	600	-	1	600
1992	461,4	341,1	V.D.	-	-	-	600	600	-	2	1200
1993	614,7	380,3	D.	-	-	400	400	400	-	3	1200
1994	495,4	362,9	D.	-	-	-	500	500	-	2	1000
1995	587,9	382,1	D.	-	-	-	500	500	-	2	1000
1996	549,9	345,7	D.	-	-	-	500	500	-	2	1000
1997	721,5	562,4	R.	-	-	-	-	-	-	0	0
1998	679,6	485,0	V.R.	-	-	-	-	400	-	1	400
1999	747,6	573,8	Ex.R.	-	-	-	-	-	-	0	0
2000	433,8	274,9	Ex.D.	-	-	500	500	500	-	3	1500
2001	633	340,0	Ex.P.			-	500	-	-	1	500
2002	468	438	M			400	500	600	-	3	1500
Mean or frecquency	568,5	405,3	R	3	2	13	22	29	3	-	0 - 1800

Climatic character of year: Ex.S. = Excessive droughty, R. = Rainy, V.D. = very droughty, V.R. = Very rainy, D. = droughty, Ex.R. = Excessive rainy, M = mean;

Table 4. Yields of principals field crops in irrigation and nonirrigation conditions, Cluj-Napoca, 1964-2002(t/ha)

Years	Wheat		Maize		Soybean		Potato		Sugar beet	
	Nonirri-gated	Irri-gated	Nonirri-gated	Irri-gated	Nonirri-gated	Irri-gated	Nonirri-gated	Irri-gated	Nonirri-gated	Irri-gated
1964	-	-	7,6	10,4	3,0	3,9	22	35	43	61
1965	-	-	3,6	6,1	2,8	3,7	16	21	46	69
1966	-	-	4,8	5,4	3,2	3,9	27	31	61	67
1967	-	-	5,1	8,0	2,5	3,4	33	46	38	47
1968	-	-	7,0	8,4	2,7	3,6	38	49	38	50
1969	-	-	7,5	8,0	2,5	2,8	23	25	61	66
1970	-	-	4,2	4,9	3,3	4,7	19	24	29	37
1971	-	-	6,8	7,2	3,2	3,9	27	31	45	53
1972	-	-	7,0	9,2	3,2	3,8	50	58	63	83
1973	-	-	5,2	8,4	3,4	4,2	26	30	26	37
1974	-	-	4,6	9,9	2,8	3,2	26	32	36	48
1975	-	-	8,6	8,6	3,1	3,1	12	12	45	45
1976	-	-	4,8	6,3	2,7	3,6	28	37	45	66
1977	-	-	6,8	7,4	2,2	3,8	27	35	53	72
1978	-	-	4,1	4,9	2,5	3,2	28	37	51	62
1979	-	-	4,4	5,7	2,9	3,3	36	39	58	71
1980	-	-	4,6	4,6	3,1	3,1	24	24	55	55
1981	4,5	6,3	7,5	9,4	2,3	3,7	25	29	47	65
1982	3,9	6,2	9,0	10,4	2,6	3,5	32	46	48	67
1983	4,6	5,8	4,9	8,5	2,3	3,4	33	43	40	70
1984	3,4	5,3	6,7	8,4	3,8	4,2	54	69	45	70
1985	5,4	8,9	7,5	10,8	2,2	3,4	38	45	42	75
1986	4,0	6,0	9,5	14,5	1,2	2,2	42	55	41	64
1987	5,3	7,4	8,6	14,7	1,5	3,8	38	42	32	54
1988	5,6	7,6	11,9	14,5	2,2	4,0	35	43	44	60
1989	6,9	8,7	9,3	11,7	3,8	5,5	39	48	70	84
1990	8,4	9,3	8,6	11,8	3,2	3,8	25	37	36	60
1991	5,3	6,3	5,8	7,1	2,3	3,2	21	37	40	57
1992	6,4	7,2	5,2	6,5	3,3	3,9	27	38	40	53
1993	4,9	5,3	7,9	9,0	2,1	3,0	26	32	32	39
1994	5,2	6,9	6,4	8,6	2,7	3,3	14	21	41	72
1995	4,8	7,2	6,3	8,0	2,3	3,1	16	20	37	43
1996	-	-	7,1	8,1	3,2	3,7	35	41	46	60
1997	-	-	6,4	8,5	2,8	3,6	28	39	38	38
1998	-	-	7,3	9,7	2,7	3,8	14	25	32	48
1999	-	-	6,9	8,3	2,9	3,3	16	25	37	52
2000	-	-	4,3	6,7	2,4	3,7	26	43	36	53
2001	-	-	5,7	6,3	1,9	2,9	27	36	35	48
2002	-	-	6,3	7,1	2,3	3,2	28	38	37	52
M	5,24	6,96	6,5	8,5	2,47	3,50	28,2	36,4	43,3	55,3
Increase par Irrigation %	100	132,8	100	130,7	100	128,5	100	129,0	100	134,6

Table 5.Yield of soybean depending on moisture soil depth, Mean 1989-1992

No.of variant	Moisture soil depth (cm)	Irrigation depth (m³/ha)	Yield			
			t/ha	%	Dif.	Signif.dif.
V-1	Nonirrigated	-	3,2	100	-	-
V-2	50	400	3,5	109,4	0,3	xxx
V-3	75	600	3,9	121,8	0,7	xxx
V-4	100	800	3,7	115,6	0,5	xxx

DL 5 % = 0,10
DL 1 % = 0,20
DL 0,1 % = 0,30

Table 6.Yield of maize depending on moisture soil depth, Mean 1984-1988

No.of variant	Moisture soil depth (cm)	Irrigation depth (m³/ha)	Yield			
			t/ha	%	Dif.	Signif.dif.
V-1	Nonirrigated	-	8,5	100	-	-
V-2	50	400	9,2	108,2	0,7	-
V-3	75	600	13,2	155,3	4,7	xxx
V-4	100	800	11,5	135,2	3,0	xxx

DL 5 % = 0,91
DL 1 % = 1,23
DL 0,1 % = 1,67

Table 7. Yield of sugar beet depending on moisture soil depth, Mean 1986-1990

No.of variant	Moisture soil depth (cm)	Irrigation depth (m³/ha)	Roots				White sugar			
			t/ha	%	Dif.	Signif.dif.	t/ha	%	Dif.	Signif.dif
V-1	Nonirrigated	-	44	100	-	-	6,6	100	-	-
V-2	50	400	59	134	15	xxx	8,7	132	2,1	xxx
V-3	75	600	64	145	20	xxx	9,1	138	2,5	xxx
V-4	100	800	61	138	17	xxx	8,3	126	1,7	xxx
		DL 5 % = 4,01					0.70			
		DL 1 % = 5,63					0,98			
		DL 0,1 % = 7,95					1,39			

Table 8. Yield of potato depending on moisture soil depth, Mean 1990-1992

No.of variant	Moisture soil depth (cm)	Irrigation depth (m³/ha)	Yield				Starch			
			t/ha	%	Dif.	Signif. Dif.	t/ha	%	Dif.	Signif. dif.
V-1	Nonirrigated	-	22,1	100	-	-	3,96	100	-	-
V-2	50	400	29,1	131,6	7	x	5,28	133,3	1,32	x
V-3	75	600	34,1	154,3	12	xx	6,22	157,0	2,26	xx
V-4	100	800	34,1	154,3	12	xx	6,12	154,5	2,16	xx
		DL 5 % = 5,61				1,02				
		DL 1 % = 8,49				1,52				
		DL 0,1 % = 13,54				2,47				

CONCLUSIONS

1. From the analysis of the results of the experiments on 39 years in Cluj-Napoca, it can be ascertained that in the subhumid area of Transylvania, the irrigation of cultures constitutes a resolute method in the achievement of constantly high productions per ha.
2. The growth of the water rate in this area is of 400-600 m³ water/ha and the irrigation rate in this area is of 1000-1200 m³ water/ha, carried out in 2-3 watering, especially in the months of July and August, when the plants have high water consumption.
3. The depth of moisture of the soil is of 50-75 cm, varying with the thickness of the active layer and with the cultivated crop.

REFERENCES

[1]. Luca, E., 1997: Irigarea porumbului în zona subumedă a Transilvaniei, Ed.Grand, Bucureşti.
[2]. Luca, E., Nagy, Z., 1999: Irigarea culturilor, Ed.Genesis, Cluj-Napoca.
[3]. Nagy, Z., F.Bianu, Margareta Nagy, 1972: Rezultate pe 15 ani privind irigarea porumbului pentru boabe şi siloz în condiţiile subumede din Câmpia Transilvaniei, Buletinul IACN, Seria A, vol.33, p.47-52.
[4]. Nagy, Z., Luca, E., Turdean Al., 1994: Regimul de irigare şi consumul de apă la principalele culturi de câmp din Transilvania, Buletinul USACN, Seria A-H, vol.48/2, p.85-91.
[5]. Nagy, Z., Luca, E., Margareta Berchez, 2002: Irrigation Regime of theMain Field Crops in Transilvania, Buletinul USAMV CN, Seria H, vol.57 p.298-302.

Nagy Zoltan,
Emil Luca, **emil.luca@email.ro,**
Margareta Berchez

University of Agricultural Science and Veterinary Medicine, Faculty of Horticulture
3-5 Manastur Street, 3400 Cluj-Napoca, Romania,
Phone: + 40-264-196.384,
Fax: + 40-264-193.792